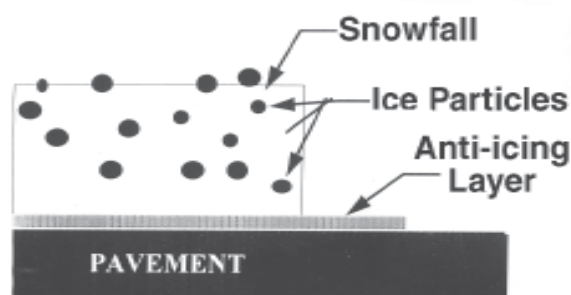


ANTI-ICING TECHNOLOGY

Anti-icing is the practice of preventing the formation of bonded snow or ice to the pavement by timely applications of a chemical freezing-point depressant. This proactive approach differs from conventional deicing practices which requires the application of a melting agent as a reaction to the accumulation of snow and ice on the pavement.

While anti-icing is not a new concept, the development, availability, and cost reduction of anti-icing chemicals and application equipment has made it a valuable addition to winter storm fighting techniques. Case studies in Washington and 14 other states (sponsored by the Federal Highway Administration's Strategic Highway Research Program) have shown that anti-icing improves service levels, reduces maintenance costs, improves air quality, and can be applied during better road conditions.



Anti-icing chemicals keep snow and ice from bonding to the pavement surface.

Anti-icing Basics

Anti-icing is a systematic approach to winter road maintenance that can be adapted to an agency's unique conditions and available tools. It includes three critical components: operations, decision making, and personnel. The operations component consists of the winter maintenance forces' capability for the timely application of chemicals to the roadway in a solid, prewetted solid, and/or liquid form. This component also includes plowing accumulated snow and ice from the pavement so that a second application of chemicals can be applied to a clear-as-possible pavement surface if necessary. The equipment and materials needed to support these activities consists of on-truck storage tanks and spreaders, anti-icing materials, solid and liquid chemical storage facilities, and plows with appropriate cutting edges. Anti-icing materials include liquid sodium chloride (salt brine), liquid calcium chloride, liquid magnesium chloride, liquid calcium magnesium acetate, liquid potassium acetate, and fine-graded salt prewetted with some liquid. Some liquids are used to prewet salt, and some are sprayed directly on the road surface as the anti-icing agent.

Decision-making components necessary to support anti-icing include weather service forecasts, real-time conditions of pavement surfaces and road weather information. This information can be obtained from road weather information systems



(RWIS), if available, nowcasting (the use of real-time data for short-term forecasting), traffic information, information on present pavement observations and friction measurements from patrols, and post-storm evaluations of treatment effectiveness. Anti-icing demands accurate, local weather and storm prediction data. Applying the material on the roadway too early or too late may be wasteful and ineffective.

The personnel component consists of personnel stand-by and call-in procedures, and personnel trained to use available weather and pavement data in the decision making process. After the initial application of anti-icing material, personnel, materials, and equipment must be available and prepared for re-application as the conditions dictate.



Portable spray unit mounted in pickup truck bed.

Case Studies

In the first of three case studies conducted by the Washington Department of Transportation, materials were applied to two sections of 20 lane miles each. Road conditions consisted of heavy frost and ice resulting from scattered days of accumulating ground moisture interspersed with clear, cool, sunny days and below freezing nights. The average traffic was about 2,500 vehicles.

On one section, traditional methods of deicing

were used – repeated applications of sand and chemical. Overtime labor and equipment charges were high, because the time period included a holiday weekend.

On the other section, anti-icing was used. The pretreatment consisted of liquid magnesium chloride at the rate of 30 gal./lane mi.

Both methods worked. The pretreatment cost were \$383, while the traditional method costs were \$4,400, or 11.5 times greater.

In the second instance, treatment comparisons were made on 23 mi. of Interstate highway, covering four travel lanes, including bridges and underpasses. This section of road has an ADT of 42,000. Conditions were periods of snow flurries and rain. The temperature ranged from 25 to 35 degrees F, with ice and heavy frost build-up.

On the conventionally treated section, applications of sand mixed with granular chemical deicer were applied every 1 to 2 hours. A total of 60 yards of sand was mixed 10:1 with granular chemical deicer.

On the pretreated section, 1,000 gallons of liquid CMA was used. Cost for the pretreatment section was \$1,360. Cost of the traditional deicing work was \$4,179.

The third study compared the costs for controlling ice on bridges. Conditions were heavy frost and ice, with average daily traffic of about 2,200 vehicles.

In traditional deicing, each bridge required about 2 yards of sand per day, applied in numerous trips at different times during the day.

Using pretreatment, one treatment per bridge, with magnesium chloride was enough.

Cost of traditional treatment averaged \$257 per bridge, excluding sweeping, and \$302 per bridge, including sweeping.

Cost of anti-icing averaged \$22 per bridge.

Tests in other states showed similar savings. Anti-icing pretreatments were applied to bridge decks on the Friday afternoons prior to predicted

weekend frosts. These treatments protected the bridges from frost and eliminated the expense of weekend overtime.

Test Results

One major benefit to be derived from the use of anti-icing technology is a better understanding of the conditions under which anti-icing operations should, and should not, be used. Additional benefits are:

- ◆ Improved efficiency and effectiveness of highway agencies' winter maintenance operations and cost savings in time, labor, materials, and equipment.
- ◆ Improved vehicle traction and consequently, highway safety during wintertime conditions.
- ◆ Improved levels of service of highways during wintertime conditions.
- ◆ Reduction, in certain locations of the United States, in the quantity of materials (both chemicals and abrasives) used in snow and ice control.
- ◆ Reduced environmental and infrastructure impact of snow and ice control operations in sensitive areas.
- ◆ Improved knowledge concerning the use of liquid chemicals and prewetted solids in anti-icing operations.

The FHWA/SHRP field tests have shown that while an anti-icing strategy may not be appropriate for every storm, it is a valuable tool for fighting some winter storms, for pavement frost control operations, and to help eliminate "black ice" conditions. The tests indicate that anti-icing materials are most effective when applied prior to the pavement temperature reaching the freezing point. The material's continued effectiveness depends upon the temperature and the chemical used. When storm temperatures and conditions continue to decline, agencies should switch to their deicing program. High winds, heavy drifting, and prolonged heavy snow conditions

also limit the effectiveness of anti-icing practices. However, applying anti-icing chemicals to the pavement prior to the storm will hinder the snow pack from bonding to the pavement and will aid in snow removal once conditions improve.

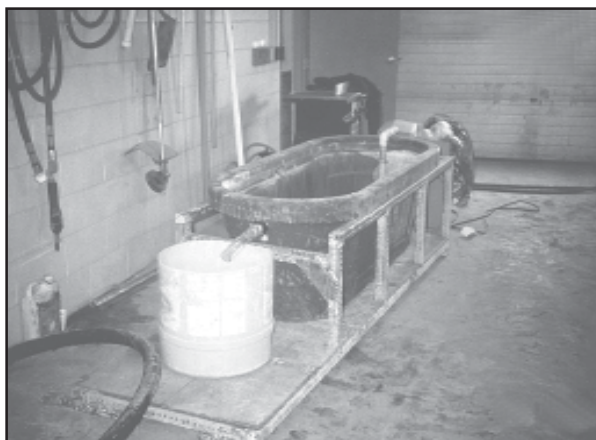


Tailgate mounted Anti-icing chemical tank.

Team Participation

Several agencies participating in the tests noted that anti-icing must be a team effort and that everyone associated with the anti-icing process must be involved from the very beginning. Everyone must understand the new technology and the expectations of new methods to achieve the desired results. The more information everyone has the easier it is to get a program established which achieves a higher level of service at potentially less cost. Total team involvement also provides a greater chance of program success.

Another important element of any anti-icing program is advance public information releases. The public seeing chemicals spread (especially if the chemical is liquid) before the snow accumulates will generate some inquiries if not complaints. Advance information can turn negative public reaction into positive public reaction.



Homemade salt brine maker

Post Storm Assessment

Lessons can be learned from both successes and failures of any winter maintenance operation. Anti-icing operations are no exception. Improvements in operations, and even equipment, can be identified and implemented through a post-storm assessment of the practices and treatments used. It is important that all levels of maintenance personnel be involved in these evaluations. As part of the post storm assessment, it is suggested that the highway agency track the cost and effectiveness of the anti-icing program, and, if possible, do the same for conventional snow and ice control operations in comparable areas.

The costs and effectiveness measures of the anti-icing and conventional operations need to be recorded separately for each highway section or route considered. The cost per lane mile can then be calculated for each type operation, effectiveness measures can be evaluated, and the relative success of the two operations compared.

Whether examining costs or success of anti-icing operations, an examination of both costs and level of maintenance effectiveness is important. This examination can lead to adjustments in operating procedures, the use of alternative anti-icing chemicals, chemical storage systems, delivery methods and

application equipment.

Anti-icing techniques provide the potential for maintaining roads in the best conditions possible during winter storms and often at a lower cost than conventional snow and ice control methods. A post-storm assessment can lead to changes to improve the efficiency and effectiveness of an anti-icing program to take advantage of this potential.

For More Information

For additional information on Anti-icing, the Technology Transfer Center has publication P013 – “Manual of Practice for an Effective Anti-icing Program” and videotape 056 – “What is Anti-icing and Anti-icing for Maintenance Personnel” available in the Videotape/Publication Library.

This article was prepared from information appearing in the Manual of Practice for an Effective Anti-icing Program, FHWA-RD-95-202, Snow and Ice Control Chemicals Theory and Practice by Dale Keep and Dick Parker, 1996 and Better Roads Magazine, June 1998.